

**Arizona Department of Agriculture
Arizona Iceberg Lettuce Research Council
Final Report for 2003-2004**

Evaluation of lettuce cultivars for resistance to Fusarium wilt

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Abstract

Fusarium wilt of lettuce was first recognized in Arizona in 2001. The pathogen, *Fusarium oxysporum* f.sp. *lactucae*, has been recovered from infected lettuce plants in 27 different fields during the last three years. This fungus is a soil-borne pathogen that can remain viable in soil for many years. Historically, Fusarium wilt on crops other than lettuce, such as tomatoes and melons, has been achieved by planting cultivars resistant to the fungal pathogen. Large scale field trials were conducted during the 2002-03 and 2003-04 production seasons to evaluate existing lettuce cultivars for their relative susceptibility to Fusarium wilt. The main findings from these trials are summarized below.

1. Among virtually all tested lettuce cultivars, the severity of disease in the first planting (early September) was much higher than that observed in the second planting (mid October), which in turn was somewhat higher than that observed in the third planting (early December). Soil temperatures differed considerably among plantings. For example, in 2002-03 (or 2003-04) the average daily soil temperature at the 4-inch depth ranged from 65 to 85°F (70 to 94°F), 55 to 74°F (47 to 78°F), and 48 to 64°F (47 to 74°F) for the first, second and third plantings, respectively.
2. In all three plantings, differences in disease severity were detected among the different types of lettuce, with head lettuce cultivars as a group being most susceptible and romaine cultivars collectively demonstrating the highest level of tolerance.
3. Disease tolerance for specific cultivars was dependent on disease pressure. This is reflected in the comparative disease severity recorded in 2003-04 for specific cultivars (such as Beacon, Buccaneer, Coyote, Desert Heat, Lighthouse, Monolith, Red Tide, Sharpshooter, Sniper and Two Star) planted at each of the three different planting dates.
4. Disease development began as early as the seedling stage and continued up to plant maturity, demonstrating the benefit of evaluating lettuce resistance in the field compared to greenhouse studies where plants are usually not carried to maturity before final disease ratings are performed.

The graphs at the end of this report show the relative susceptibility of cultivars tested during the 2003-04 season for each of the lettuce plantings, as well as combined data for 2002-03 and 2003-04 for cultivars tested in both seasons. During the early September planting period, only the romaine cultivars Slugger and King Louie suffered losses (due to dead or stunted plants) below 10%. On the other hand, at the second (October) and third (December) planting dates, several crisphead, romaine, and leaf lettuce

cultivars showed little or no damage due to the *Fusarium* present in the soil. The data from these cultivar evaluation trials suggest that proper selection of planting date and cultivar would allow successful production of lettuce in fields infested with *Fusarium oxysporum* f.sp. *lactucae*.

Introduction

Fusarium wilt of lettuce was first recognized in Arizona in 2001. The pathogen, *Fusarium oxysporum* f.sp. *lactucae*, has been recovered from infected lettuce plants in 27 different fields during the last three years. This fungus is a soil-borne pathogen that can remain viable in soil for many years. Disease symptoms include wilting, yellowing of leaves and a red-brown to black discoloration of internal taproot and crown tissue. Affected plants are stunted and often die. This wilt disease affects lettuce plants of all ages, from seedling to mature plant.

Fusarium wilt is new to Arizona lettuce fields; however, the disease was first discovered on this crop in Japan in 1955. The first discovery of Fusarium wilt of lettuce in the United States occurred during 1990 in Fresno County near Huron, California. Most recently, the disease was reported in Italy in 2002. The fungus that causes Fusarium wilt is a soil-borne pathogen that can remain viable in soil for many years.

A research paper published in 1993 by Hubbard and Gerik (1) is the current primary source of information concerning the disease cycle and epidemiology of Fusarium wilt of lettuce in the western United States. Hubbard and Gerik determined in the laboratory that the fungus can grow between 46 and 89°F, with optimum growth at 82°F. Lettuce was not susceptible to any of the Fusarium wilt pathogens from other crops, including tomatoes and melons. Likewise, no other hosts have been found for *Fusarium oxysporum* f.sp. *lactucae*. In seedling inoculation experiments, the researchers found that the lettuce cultivars Autumn Gold, Empire, Excell, Salinas, Vanguard, Vanguard 75, Vanmax, Viva and Winterset were susceptible to the disease in varying degrees, with Salinas demonstrating the most disease tolerance.

Fusarium wilt presents a serious threat to the health of the lettuce industry in Arizona. An effective method of managing Fusarium wilt in other crops, such as tomatoes and melons, is to plant cultivars resistant to the pathogen. In the long term, development of lettuce cultivars with resistance to *Fusarium oxysporum* f.sp. *lactucae* would be highly desirable. As the development of such resistant cultivars will take considerable time, more immediate disease management tools are needed. In the short term, we set out to evaluate existing lettuce cultivars for their relative susceptibility to Fusarium wilt. Such evaluation trials were conducted during the 2002-03 and 2003-04 production seasons by establishing replicated plantings of lettuce cultivars in a field known to contain *Fusarium oxysporum* f.sp. *lactucae*.

Materials and Methods

Large field trials were established on a commercial lettuce field farmed by Coronation Peak Ranches in Wellton, Arizona. Plots were planted and managed using current commercial practices. Each of the four replicate plots for each lettuce cultivar contained from 180 to 600 lettuce plants, depending upon the particular planting and year. Tested cultivars were grouped into three different planting dates: Sep 7, Oct 17 and Dec 6 in 2002 and Sep 3, Oct 21 and Dec 18 in 2003. A majority of the cultivars within each planting date were those that would be planted in the desert at that time. The remainder of the cultivars were included for comparison of disease on the same cultivar at different planting dates or for evaluation of cultivars not grown commercially in the desert. Termination dates for each planting and the number of cultivars of each lettuce type within each planting are listed in Table 1. Disease evaluations were performed

three times during crop development in each planting. Only the final disease rating at crop maturity is presented in this report. Each plant within a plot was determined to be diseased if the plant was dead or stunted and displayed the typical wilting and yellowing symptoms of Fusarium wilt of lettuce.

Table 1.

| Table 1: | | | | | | | | |
|-----------------|---------------|---------------|------------------|--|---------|------------|----------|--------|
| Planting number | Planting date | Maturity date | Days to maturity | Number of cultivars tested of each lettuce type. | | | | |
| | | | | Crisphead | Romaine | Green leaf | Red leaf | Butter |
| 2002-03 season | | | | | | | | |
| 1 st | Sep 7 | Nov 8 | 62 | 41 | 15 | 3 | 4 | 2 |
| 2 nd | Oct 17 | Jan 11 | 86 | 40 | 9 | 4 | 3 | ---- |
| 3 rd | Dec 6 | Mar 22 | 107 | 40 | 4 | 1 | 1 | 1 |
| 2003-04 season | | | | | | | | |
| 1 st | Sep 3 | Nov 6 | 64 | 38 | 14 | 2 | 4 | 3 |
| 2 nd | Oct 21 | Jan 26 | 97 | 34 | 10 | 4 | 4 | 2 |
| 3 rd | Dec 18 | Mar 22 | 95 | 33 | 4 | 1 | 1 | 1 |

Results and Discussion

The percentage of dead or stunted plants at the conclusion of the first, second and third plantings during the 2003-04 season is presented in the graphs at the end of this report. The combined data for 2002-03 and 2003-04 for cultivars tested in both seasons is presented as well. Among virtually all tested cultivars of lettuce, the severity of disease in the first planting was much higher than that observed in the second planting, which in turn was somewhat higher than that observed in the third planting. One reason for the differences in disease severity among planting dates was soil temperature. In 2002-03 (or 2003-04) the average daily soil temperature at the 4-inch depth during the first, second and third plantings ranged from 65 to 85°F (70-94°F), 55 to 74°F (47 to 78°F), and 48 to 64°F (47-74°F), respectively.

In all three plantings, differences in disease severity were detected among the different types of lettuce, with head lettuce cultivars as a group being most susceptible whereas romaine cultivars collectively demonstrated the highest level of tolerance. Disease tolerance for specific cultivars was dependent on disease pressure. This is reflected in the comparative disease severity recorded in 2003-04 for specific cultivars (such as Beacon, Buccaneer, Coyote, Desert Heat, Lighthouse, Monolith, Red Tide, Sharpshooter, Sniper and Two Star) planted at each of the three different planting dates. Furthermore, disease development, especially during the first planting, began at the seedling stage and continued up to plant maturity, demonstrating the benefit of evaluating lettuce resistance in the field compared to greenhouse studies where plants are usually not carried to maturity before final disease ratings are performed.

During the early September planting period, only the romaine cultivars Slugger and King Louie suffered losses (due to dead or stunted plants) below 10%. On the other hand, at the second (October) and third (December) planting dates, several crisphead, romaine, and leaf lettuce cultivars showed little damage due to the Fusarium present in the soil. The data from these cultivar evaluation trials suggest that proper selection of planting date and cultivar would allow successful production of lettuce in fields infested with *Fusarium oxysporum* f.sp. *lactucae*.

Fusarium wilt was detected in Yuma County lettuce fields from October through December; therefore, head

lettuce fields in production during this time that exhibited no evidence of *Fusarium* wilt can be assumed to be free of the pathogen. On the other hand, lettuce fields in production during January through March and showing no evidence of *Fusarium* wilt still may harbor the pathogen, since disease development during this time is greatly reduced and could easily be overlooked.

Recommendations

Considering what is known about *Fusarium* wilt on crops other than lettuce, as well as data gathered from cultivar evaluation trials during the past 2 years and observations of disease development in commercial fields during the past 3 years, there are some recommendations that can be made concerning the management of *Fusarium* wilt of lettuce.

1. Every effort should be made to prevent the spread of contaminated soil from known locations of *Fusarium oxysporum* f.sp. *lactucae* to “clean” fields by workers and equipment. These precautions should be maintained even when crops other than lettuce are grown in infested fields.
2. The only way to completely avoid *Fusarium* wilt on lettuce is to plant the crop on sites known to be free of the pathogen. However, based on data from 2 years of evaluation of lettuce cultivars on a field heavily infested with *Fusarium oxysporum* f.sp. *lactucae*, proper selection of cultivar and planting date can allow successful production of lettuce in infested fields with little or no losses due to *Fusarium* wilt.
3. For the vast majority of lettuce production fields that are not infested with *Fusarium oxysporum* f.sp. *lactucae*, normal criteria for cultivar and planting time selection can be used. Also, maintain vigilance to prevent the introduction of the pathogen into these fields.

Acknowledgements

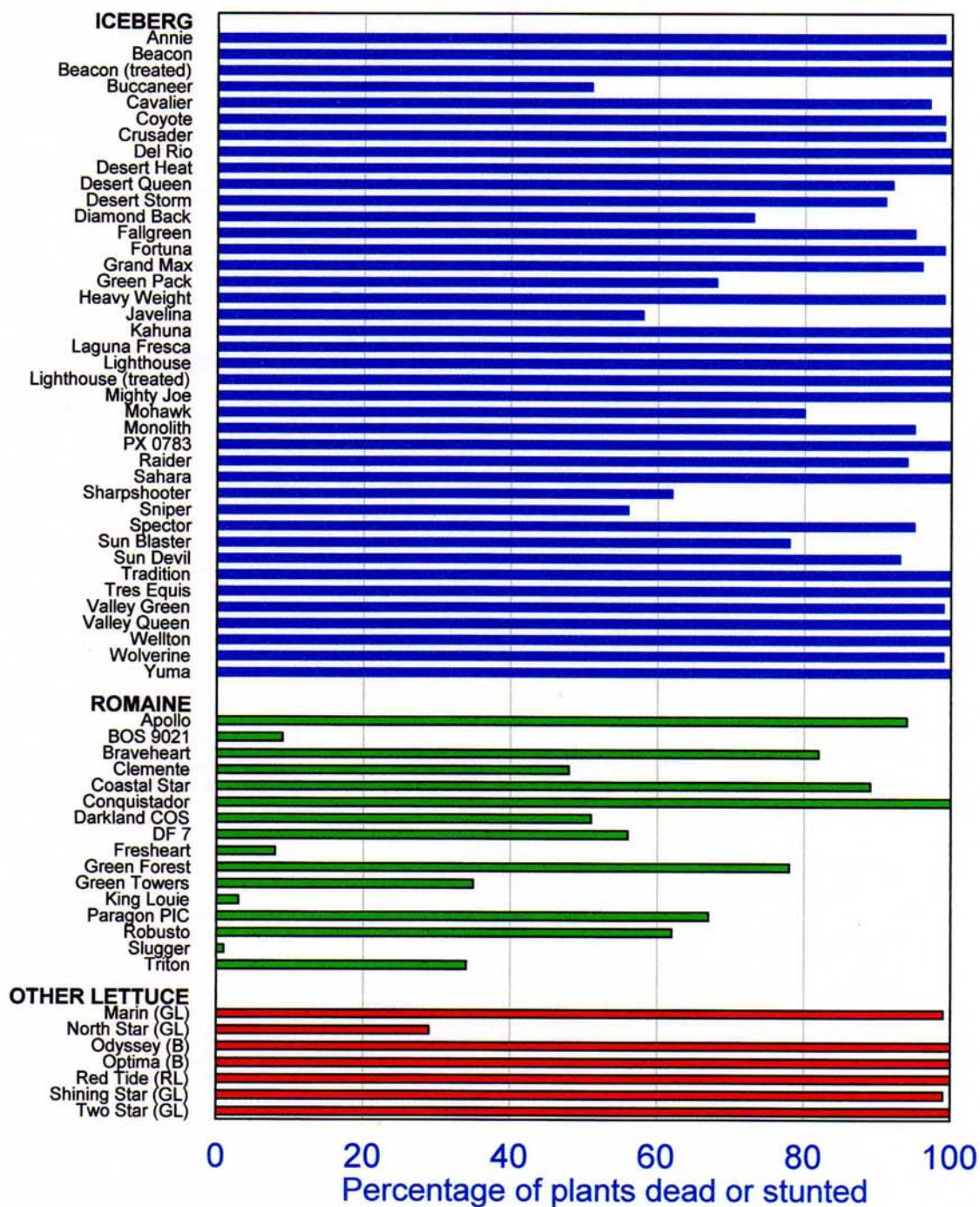
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Reference

Hubbard, J.C., and Gerik, J.S. 1993. A new wilt disease of lettuce incited by *Fusarium oxysporum* f.sp. *lactucum* forma specialis nov. Plant Dis. 77:750-754.

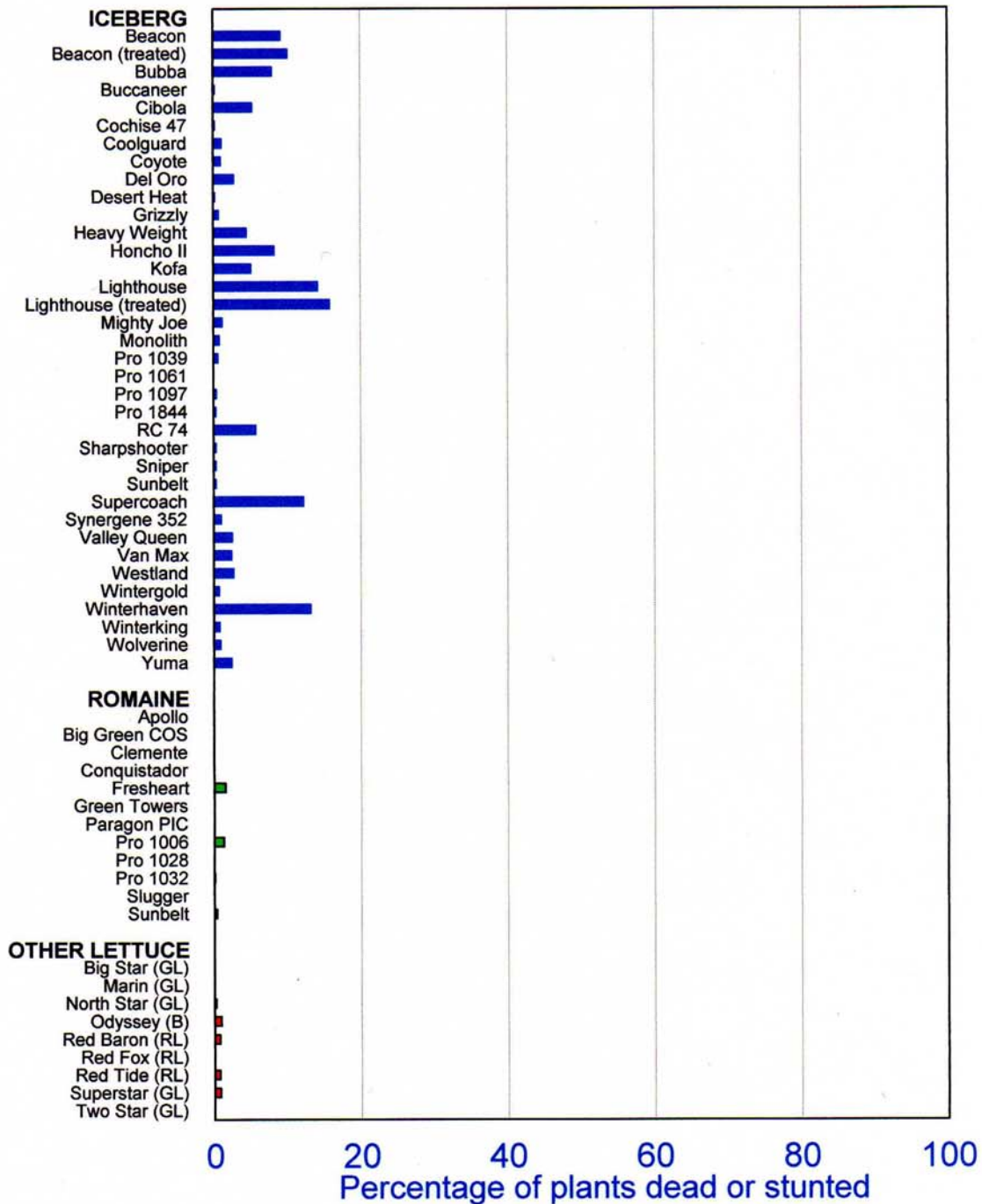
Lettuce cultivar susceptibility to Fusarium wilt

2003-04 - First planting



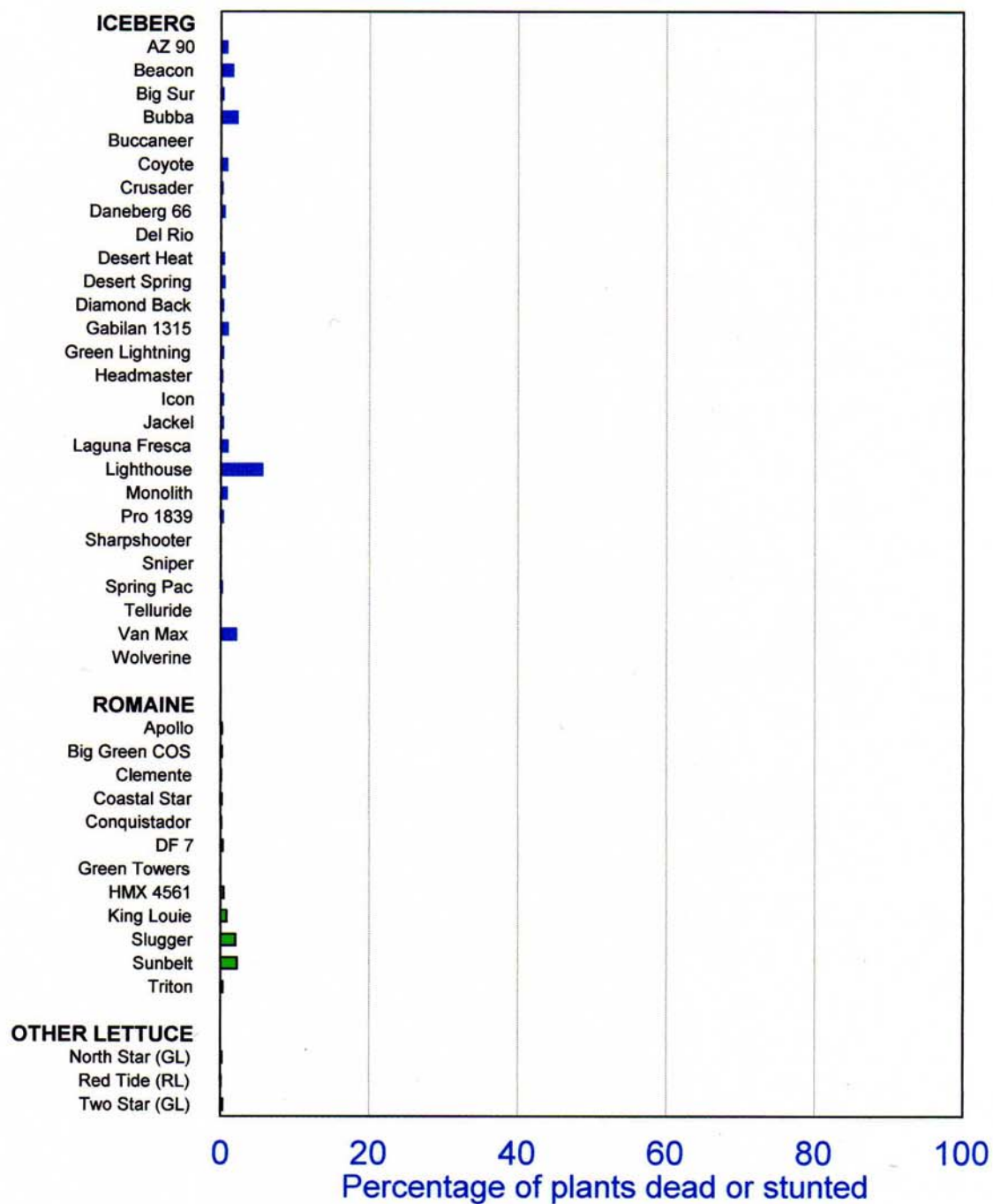
Lettuce cultivar susceptibility to Fusarium wilt

2003-04 - Second planting



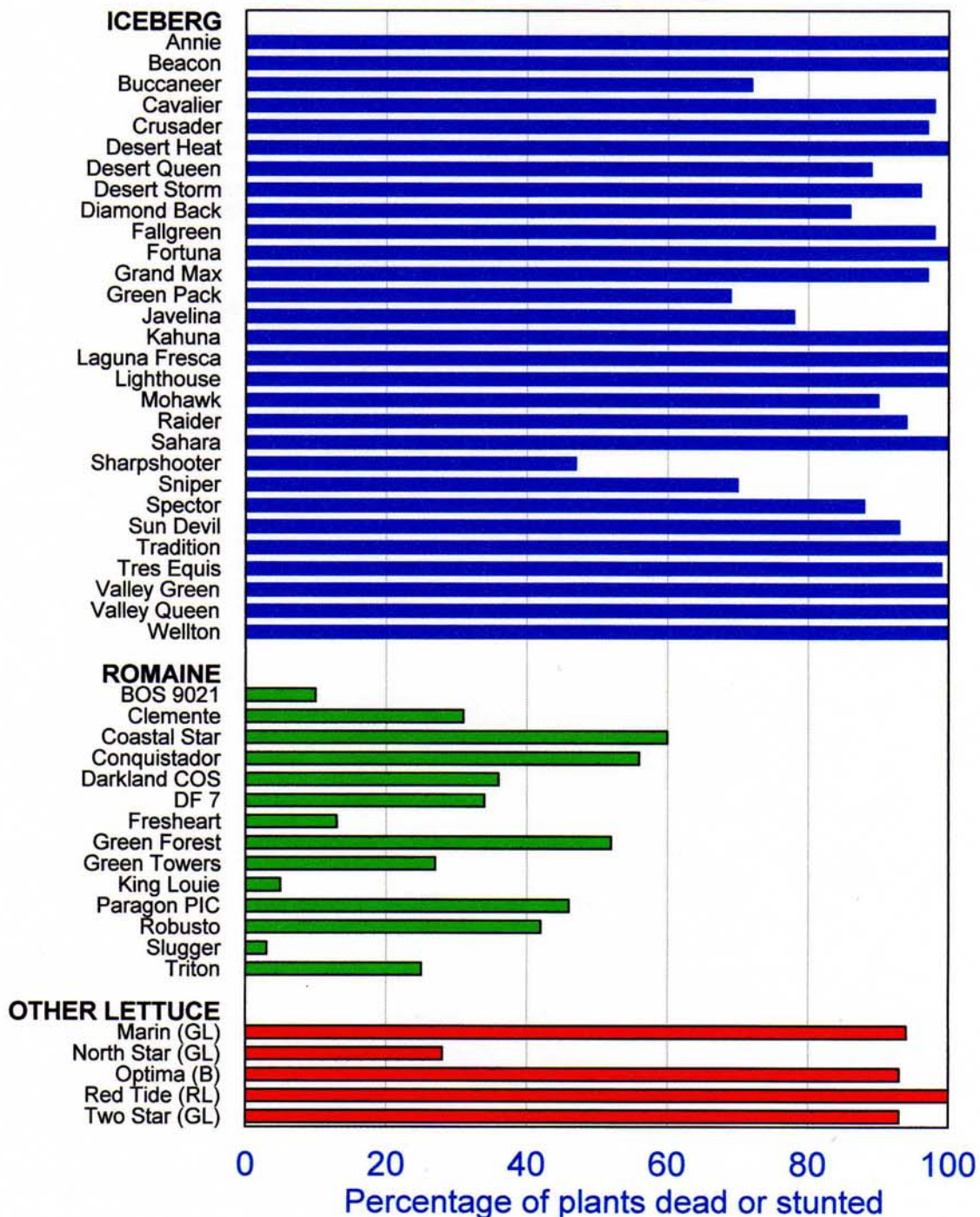
Lettuce cultivar susceptibility to Fusarium wilt

2003-04 - Third planting



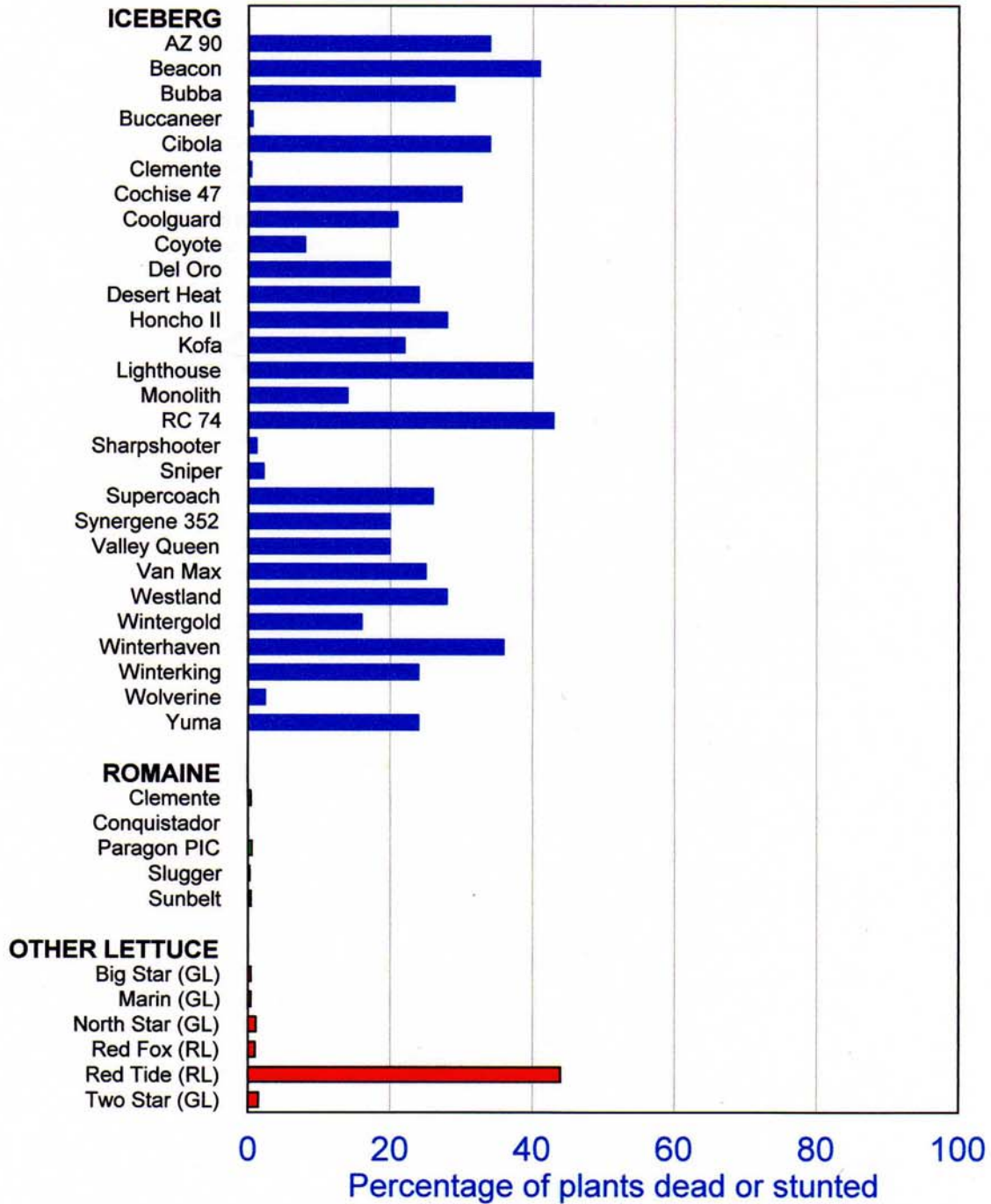
Lettuce cultivar susceptibility to Fusarium wilt

2-year average - First planting



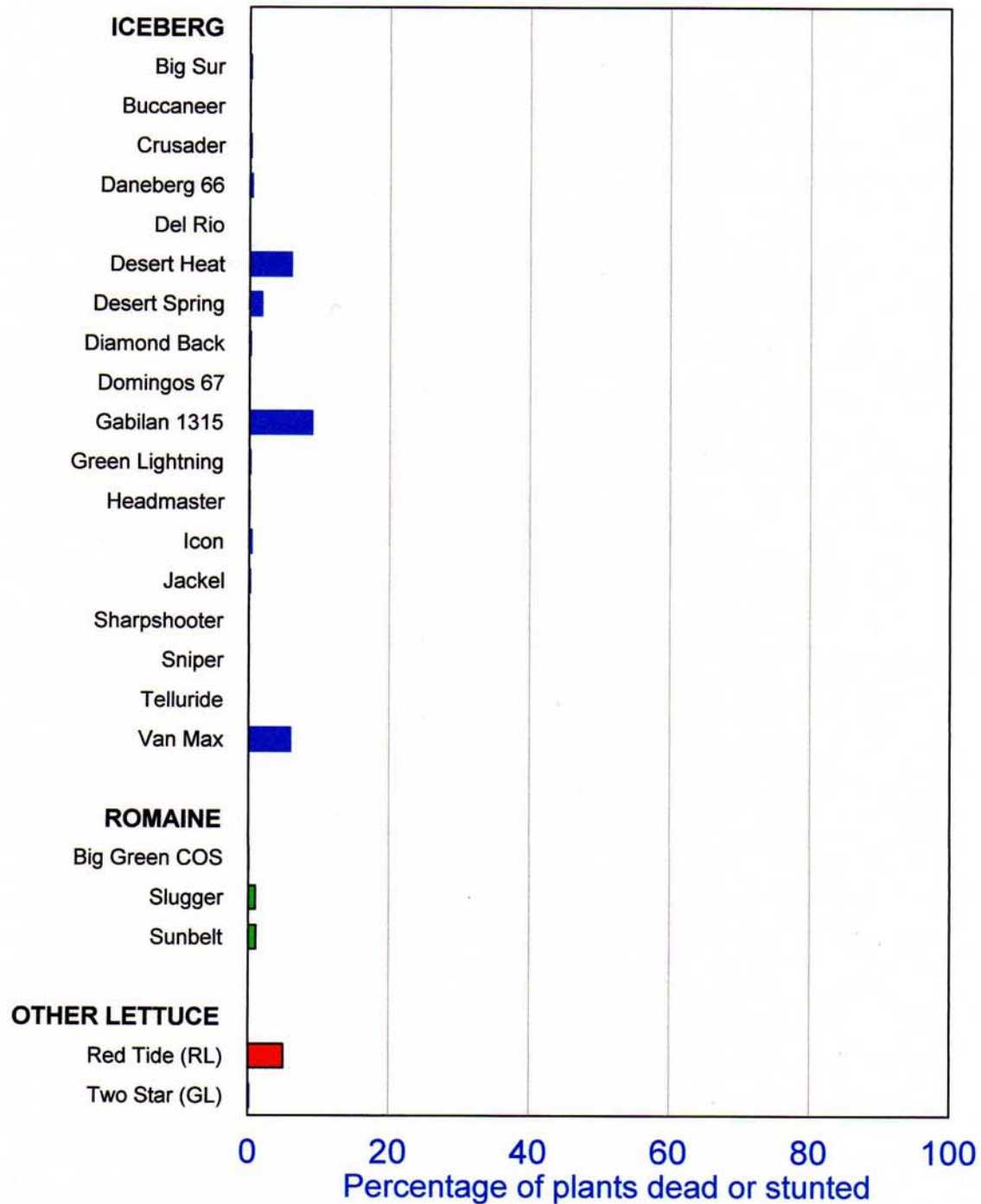
Lettuce cultivar susceptibility to Fusarium wilt

2-year average - Second planting



Lettuce cultivar susceptibility to Fusarium wilt

2-year average - Third planting



Lettuce Fusarium cultivar trial - final report for 2003-04 study.wpd